

**What Is Claimed Is:**

1. A detection apparatus for detecting a process end point in one of a layer formation process for forming one of a metal electrode layer and an insulating layer on a substrate, and in a removal process for a layer, from a signal waveform obtained by irradiating a substrate face with light and detecting at least one of a reflected signal light and a transmitted signal light; the detection apparatus comprises:

a characteristic quantity extraction component for extracting two or more characteristic quantities from the signal waveform, and a logical operation component for using the two or more characteristic quantities to perform a logical operation and determine the process end point.

2. The detection apparatus of Claim 1, wherein the signal waveform is a spectral waveform, and the characteristic quantities are selected from a characteristic quantity group consisting of local maxima in the signal waveform, a largest local maximum, local minima, a smallest local minimum, local maximum/local minimum values, a largest local maximum/a smallest local minimum,  $|\text{local maximum} - \text{local minimum}|$  for adjacent local maximum/local minimum pairs, a sum of various  $|\text{local maximum} - \text{local minimum}|$  for a plurality of local maximum/local minimum pairs, an integral value of the signal waveform, a group of first-order and second-order time differential coefficients for each of

the characteristic quantities, and a group of positive and negative signs of the time differential coefficients.

3. The detection apparatus of Claim 1, wherein the logical operation component makes its determination using fuzzy logic.

4. The detection apparatus of Claim 2, wherein the logical operation component makes its determination using fuzzy logic.

5. The detection apparatus of Claim 3, where membership functions used in the fuzzy logic are tuned during detection by means of values computed from the characteristic quantities.

6. The detection apparatus of Claim 4, where membership functions used in the fuzzy logic are tuned during detection by means of values computed from the characteristic quantities.

7. A detection apparatus for detecting a process end point in one of a layer formation process for forming one of a metal electrode layer and an insulating layer on a substrate, and in a removal process for a layer, from a change in a characteristic quantity extracted from a signal waveform obtained by irradiating a substrate face with light and

detecting at least one of a reflected signal light and a transmitted signal light; the detection apparatus comprises:

a characteristic quantity extraction component for extracting a characteristic quantity from the signal waveform, wherein the signal waveform is a spectral waveform, and wherein the characteristic quantity is one of a |local maximum – local minimum| for adjacent local maximum/local minimum pairs in the signal waveform, a sum of various |local maximum – local minimum| for a plurality of local maximum/local minimum pairs, and an integral value of the signal waveform.

8. The detection apparatus of Claim 1, wherein the characteristic quantities are extracted from a waveform in which the signal waveform has been normalized.

9. The detection apparatus of Claim 7, wherein the characteristic quantities are extracted from a waveform in which the signal waveform has been normalized.

10. The detection apparatus of Claim 1, wherein the characteristic quantities are extracted from a waveform in which the signal waveform has undergone rotational correction.

11. The detection apparatus of Claim 7, wherein the characteristic quantities are extracted from a waveform in which the signal waveform has undergone rotational correction.

12. The detection apparatus of Claim 8, wherein the characteristic quantities are extracted from a waveform in which the signal waveform has undergone rotational correction.

13. A polishing apparatus equipped with a holder for holding a substrate, a polishing body, and a detection apparatus of Claim 1, wherein the detection apparatus detects a process end point when the substrate is polished by applying a load between the substrate and the polishing body and causing relative motion between the substrate and the polishing body in a state in which a polishing agent has been interposed between the substrate and the polishing body.

14. A polishing apparatus equipped with a holder for holding a substrate, a polishing body, and a detection apparatus of Claim 7, wherein the detection apparatus detects a process end point when the substrate is polished by applying a load between the substrate and the polishing body and causing relative motion between the substrate and the polishing body in a state in which a polishing agent has been interposed between the substrate and the polishing body.

15. A polishing apparatus equipped with a holder for holding a substrate, a polishing body, and a detection apparatus of Claim 8, wherein the detection apparatus detects a process end point when the substrate is polished by applying a load between the substrate and the polishing body and causing relative motion between the substrate and the polishing body in a state in which a polishing agent has been interposed between the substrate and the polishing body.

16. A method for manufacturing a semiconductor device comprising a stage in which a polishing apparatus of Claim 13 is used to polish a surface of a semiconductor wafer.

17. A method for manufacturing a semiconductor device comprising a stage in which a polishing apparatus of Claim 14, is used to polish a surface of a semiconductor wafer.

18. A method for manufacturing a semiconductor device comprising a stage in which a polishing apparatus of Claim 15, is used to polish a surface of a semiconductor wafer.

19. A machine readable recording medium on which is recorded a signal processing program for causing a computer to function as the characteristic quantity extraction component and the logical operation component, according to Claim 1 .

20. A machine readable recording medium on which is recorded a signal processing program for causing a computer to function as the characteristic quantity extraction component and the logical operation component, according to Claim 7 .

21. A machine readable recording medium on which is recorded a signal processing program for causing a computer to function as the characteristic quantity extraction component and the logical operation component, according to Claim 8.

22. A machine readable recording medium on which is recorded a signal processing program for causing a computer to function as the characteristic quantity extraction component and the logical operation component, according to Claim 10.

23. A detection method for detecting a process end point in one of a layer formation process for forming one of a metal electrode layer and an insulating layer on a substrate, and in a removal process for a layer, from a signal waveform obtained by irradiating a substrate face with light and detecting at least one of a reflected signal light and a transmitted signal light; the detection method comprises:

a first stage in which two or more characteristic quantities are extracted from the signal waveform, and

a second stage in which the two or more characteristic quantities are used to perform a logical operation and determination.

24. A detection method for detecting a process end point in one of a layer formation process for forming one of a metal electrode layer and an insulating layer on a substrate, and in a removal process for a layer, from a change in a characteristic quantity extracted from a signal waveform obtained by irradiating a substrate face with light and detecting at least one of a reflected signal light and a transmitted signal light, wherein the signal waveform is a spectral waveform, and the characteristic quantity is one of  $|\text{local maximum} - \text{local minimum}|$  for adjacent local maximum/local minimum pairs in the signal waveform, a sum of various  $|\text{local maximum} - \text{local minimum}|$  for a plurality of local maximum/local minimum pairs, and an integral value of the signal waveform.